



## **UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

### **DEVELOPMENT OF AN IOT-BASED BUILDING INTEGRATED PHOTOVOLTAIC (BIPV) HOME AUTOMATION SYSTEM**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

by  
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**MUHAMMAD SHAFIQ BIN SAMAN**

**B071710005**

**960320016027**

**FACULTY OF ENGINEERING TECHNOLOGY**

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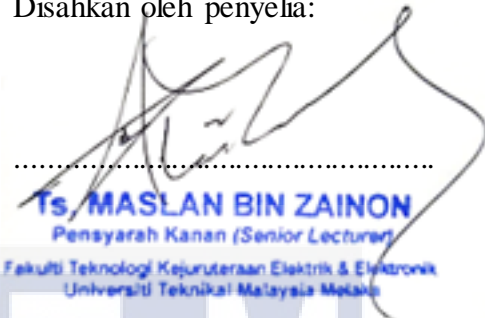
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Disahkan oleh penyelia:



**Ts. MASLAN BIN ZAINON**  
Pensyarah Kanan (Senior Lecturer)  
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik  
Universiti Teknikal Malaysia Melaka

MUHAMMAD SHAFIQ BIN SAMAN

Alamat Tetap:

Cop Rasmi Penyelia

NO.19, KAMPUNG PARIT JAWA,  
SANGLANG, AYER BALOI, 82100  
PONTIAN, JOHOR.

Tarikh: 8 / 02 / 2021

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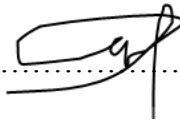
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# APPROVAL

This report submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirement for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:



## ABSTRAK

Pada masa kini, penciptaan teknologi-teknologi yang canggih telah banyak dibina oleh para jurutera dan saintis. Setiap hari pasti akan ada teknologi baru yang diperkenalkan dimata dunia yang mampu mengubah kehidupan manusia menjadi lebih cepat dan efektif. *Internet of Things* (IoT) merupakan satu daripada ciptaan canggih yang terhasil daripada titik peluh para jurutera. IoT berfungsi untuk mempermudah dan mengubah kualiti kehidupan seharian manusia secara efektif dan antara aplikasi yang mengandungi IoT ini adalah kediaman berautomasi. Mengikut daripada isu semasa, semestinya ramai pasangan suami isteri yang sibuk dengan kerja masing-masing tanpa mengupah pembantu rumah untuk menguruskan teratak kediaman mereka. Di waktu pagi yang sibuk menyiapkan anak-anak bersekolah serta diri sendiri sebelum memulakan waktu bekerja, pasti akan ada yang kelam-kabut dan tergesa-gesa mengejar masa tanpa memeriksa persekitaran rumah. Sehingakan ada yang terlupa untuk menutup lampu dan perkakasan elektrik yang mampu meningkatkan takrif bil elektrik bulanan mereka. Tujuan penyelidikan ini adalah untuk mencipta kediaman berautomasi yang bukan saja boleh mengelakkan pembaziran tapi boleh menjaga keselamatan persekitaran rumah. Sistem kediaman berautomasi ini membolehkan pengguna memantau bil bulanan dan juga status perkakasan elektrik seperti lampu, kipas, dan soket menerusi laman seswanag atas talian. Hal ini disebabkan oleh modul Wi-Fi yang bersambung dengan internet dan memudahkan pengguna untuk memantau dimana saja selagi berada di kawasan internet. Sistem ini juga mengandungi sistem sekuriti seperti pengesan kebocoran gas, penggera penceroboh dan pemercik air. Dengan menggunakan panel solar sebagai bumbung dan dinding rumah, ianya boleh memberikan sumber kuasa tenaga kepada sistem ini untuk terus berfungsi walau apa jua keadaan. Sistem ini amat sesuai untuk digunakan semua pihak komuniti terutama sekali pasangan suami isteri yang sibuk dan warga emas.

## ABSTRACT

Nowadays, the invention of advanced technologies has been widely invented by engineers and there will be new technologies introduced around the world that will make human life faster and more effective every day. The Internet of Things (IoT) is one of the most revolutionary inventions ever created by engineers around the world. The IoT function is to simplify the quality of human daily life and among the applications that used this IoT system is home automation. According to the current issues, married couples must be busy with their jobs without hiring a maid to manage their home and some of them may have trust issues from previous experiences. In the mornings, they will be busy preparing their children for going to school and also themselves before starting work to catch up on time without having to check the home environment. This usually will lead them to forget to turn off electric lights and appliances that can increase their monthly electricity bill price. The purpose of this research is to create an automated home that not only can avoid electricity waste but also can protect the home environment. This automated home system allows users to monitor their monthly bills as well as the status of electrical appliances such as lamps, fans, and sockets through online internet access. This is because of the internet that will be connected with the Wi-Fi module and makes it easy for users to monitor anywhere as long as they are connected with the internet. It also contains security systems such as gas leak detectors, intruder alarms, and water sprinklers. By adding solar panels (BIPV) on the roofs and walls, it can provide a source of energy for the system to function at all costs. This system is suitable for use by all communities, especially for the busy married couples and senior citizens.

## DEDICATION

To my beloved parents Saman bin Paiman and Norhayati binti Hj. Md. Joahir for their support and pray. Also to my siblings Nur Shakila binti Saman and Nur Fhatihah binti Saman that always helps me with financial and moral support throughout my entire life. You are my treasure which are the most precious thing in my life. I love you to the moon and back!





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## LIST OF ABBREVIATIONS

<b>LPG</b>	Liquid Petroleum Gas
<b>IoT</b>	Internet of Things
<b>BIPV</b>	Building Integrated Photovoltaic
<b>PV</b>	Photovoltaic
<b>LDR</b>	Light Dependent Resistor
<b>TNB</b>	Tenaga Nasional Berhad



# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

In this chapter, the project will be solely focusing on background, objectives, and problem statements and the purpose is to give a detailed explanation about the titles and content of the project. So, an early picture of the project can be expected about the desired outcome.

### 1.1 Background

Nowadays, the technology had already been advanced by engineers, many gadgets had already been created and one of them is the Home Automation system. The Home Automation system can be categorized as an IoT system when it connected to the internet connection. This system was designed to make a simple task that can help people in need such as turn off the light, make a coffee, and even a fingerprint door knob to open the door. The Home Automation system is consists of several electronic components that going to combine and form into one technology system. This system mainly using sensors, controlling device, and actuators to work automatically without the effort from the human ability. The system can carry on anything task based on the setting that already had been program to help other person. This system also can act as security system that will be protecting the house from anything danger according to the situation such as protect from intruder or notify user about fire. The history of the Home Automation system begin with

a small machine system that help save the labor of humans. For example, with the invention of machine such as the washing machine, dish washer, and refrigerator thanks to the introduction of electricity, it became a useful system to humans in the early 1900s. After that, the system became more advanced each day because of the expanding research of technologies that eventually lead to the invention of X10 in the year of 1975. Finally, in 2012, there are about of 1 million Home Automation systems were installed in the America, that later on, the Home Automation system were installed more than 45 million in the whole world.

## 1.2 Problem Statement

In this era of sophisticated globalization, the increase in economy and living cost had made people got busier each day. Some people are working to save money for their marriage and some people are working to achieve their lifestyle goal. Other people also working to make living to pay several basic daily expenses such as house rent, bank loan, electricity bill, and their children's tuition money. Because of that, people are getting busier with their life routines and they only had time to rest only on the weekend. Fast-paced life and frequent preoccupation with human commitments make them have not sufficient time in their house (Mieeee & Kamal, 2017). Obviously, they are too busy to clean the house and do some housework. But, the most important thing is that people always forget to switch off the light and fan in the house. Some people also forget to switch off electrical appliances such as water heater, wall fan, and television. According to (Kusriyanto & Putra, 2017), the system commonly found in conventional housing

consists of devices household device controlled manually and separately such as lights, or device entertainment devices like televisions, radios, and home theatre that also must be activated manually separately. That's why they tend to forget to switch off these devices. This will cost their living expenses to pay extra for the electrical bill and people do not want that to happen very often. Other than that, people do not have enough time to check their house surrounding conditions because of their busy life. If there is a leakage at the gas tank, this will bring unfortunate to their life. The house will burn or explode and other neighbours will also be affected. In addition to this matter, because they always busy working, the chances for their house to be rob are high and this will put a dangerous situation on the family members.

### 1.3 Objectives

In order for this project to be succeeded, the objectives which need to be achieved are:

- (a) To design and develop IoT-based circuits and hardware for home automation system that uses energy from BIPV.
- (b) To analyse the energy efficiency for the BIPV system.
- (c) To design and develop a monthly electrical bills monitoring system via Wi-Fi networks.

## 1.4 Scope of Project

For this subtopic, the scope had been laid out to achieve an expected outcome and accomplish the given task. The purpose of the project is to set up an IoT-based Home Automation system in which the Arduino Mega microcontroller will be controlling several other electronic components such as the MQ-6 gas sensor, Current sensor, and Wi-Fi Module. Users will automatically receive an alert notification as soon as the monthly electrical bill had exceeded the set limit. Once receives the notification, the user will be able to monitor and control the electrical equipment via the Wi-Fi module. Besides, the system will be adding a security system for safety purposes. By using the Wi-Fi module, the user also will receive a notification from the Gas Leakage detector once the MQ-6 Gas sensor detected any leaking gas around the gas tank. All of the components and hardware are chosen because of their functionality and specification that able to react quickly. This system will become an advantage because it can be placed at the domestic such as home and other small premises and it is useful product for the community especially to the busy married couple and senior citizens.

# CHAPTER 2

## LITERATURE REVIEW

### 2.0 Introduction

This chapter is a review of an IoT-based Home Automation system in which the Arduino Mega will act as a communication system between the other components and the BIPV solar system will be supporting as a backup supply. The data and specification about the system will be explained details later with the supporting evidence from the previous research. All of the source's data were taken mostly from journals, case reports, articles, and websites and it was based on the scope of the project that had been explained earlier.

### 2.1 Internet of Things (IoT) Technology

For this project to be successful, the IoT will be a necessary element. The ESP8266 Wi-Fi module will be activated through the system instructions and then will be connecting to the internet access for the user to monitor and control the electrical appliances even when the user not at home. When the user used the application on the mobile phone, the Arduino Mega microcontroller will receive signal data through the Wi-Fi module and the equipment can be controlled by connecting or disconnecting supply to the relay module. The system was able to be easily used by the user as they can control and monitor the system as long as there is internet access in the area.

### 2.1.1 Introduction

Internet of Things Technology is about a network capable of gathering and sharing electronic information in which made from small devices. These devices may be connected to each other and to a device or app that can control them through the Internet, Bluetooth, or other means. Generally speaking, IoT refers to scenarios where network connectivity and computing capability extends to objects, sensors, and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human intervention. This technology was also had a wide variety of functions that included about the production process that can transmit data to able track human information from the sensors.

IoT Technology uses embedded systems, such as processors, sensors, and communication hardware, which included smart devices that able to collect and send data they obtained from their surroundings. By connecting to the internet gateway, IoT devices will be able to share data collected from previous to the cloud to be analysed or getting analysed manually. This technology able to help many people whether their life or work environment, and it is essential for the business to offer a smart device to automate people's homes. IoT devices will be able to provide the user life's routine with ease, and for sure the technologies will getting expended and popular among industries.